WATERMARK COMMUNICATION AND CONTROL SYSTEMS

Related Application Data

This patent application claims priority to U.S. Provisional Patent Application No. 60/252,939, filed November 22, 2000, which is hereby incorporated by reference.

Field of the Invention

The present invention relates to use of watermarks to convey data to electronic systems, and is particularly illustrated in the context of enhanced television systems.

Background and Summary of the Invention

Interactive television – a convergence between television and computers – has been heralded for a decade or more. To date, the technology has not found widespread acceptance. In part, this has been due to incompatibilities between television systems, such as NTSC and PAL.

One key component of interactive TV systems is a data channel to accompany the video. Numerous techniques have been proposed – the most common of which is to encode data in the vertical blanking interval (VBI) of traditional analog TV signals. Another is to modulate data onto scanline 21 – a scanline that is usually positioned off-screen. Techniques that are commonly used with NTSC sometimes don't find favor with PAL, and vice versa.

Much work has been done in recent years in the field of video watermarking – the science of conveying data through slight changes to the video information presented to the viewer ("in-band"). The changes are so slight as to be imperceptible to the viewer, yet can be recovered by suitable signal processing. Illustrative techniques are shown in the assignee's patent 6,122,403 and applications 09/138,061 and 09/164,859, and in patent documents WO99/45705, WO 00/04722...

The focus of prior art video watermarking efforts has been to implement copy control functionality (e.g., to assure that copyrighted DVD video is not copied) and to provide some ownership marking of video content.

In accordance with a preferred embodiment of the present invention, watermark technology is employed as a data channel in an interactive television system. If the

system relies on a consumer's set-top box (STB) to perform some of the system processing, the watermark processing operations can likewise be performed by the STB. Existing interactive TV systems can be modified to utilize a watermark communications channel by providing the requisite watermark processing function at a suitable layer in known interactive TV stack architectures.

A similar approach, of providing watermark functionality as an additional component of known layered architectures, can likewise permit watermark-based communication channels to be employed in existing Ethernet networks.

The foregoing and additional features and advantages of the present invention will be more readily apparent from the following detailed description.

Detailed Description

One emerging standard used in advanced television systems (and certain set top boxes) is known as ATVEF (Advanced Television Enhancement Forum – see www.atvef.com; excerpts from this site are attached as Exhibits A and B). Through this standard, video content can produced once (using a variety of different tools), and can thereafter be distributed and displayed in a variety of environments (e.g., analog & digital, cable, satellite, distribution; display using STBs, digital TVs, analog TVs, PCs, PDAs, etc.). ATVEF is built on a number of other standards, including HTML 4.0, EcmaScript 1.1, and Multicast IP. In more technical jargon, ATVEF is a declarative content specification with scripting.

Several familiar broadcast programs already employ this technology, including Wheel of Fortune, and Jeopardy, to enhance the viewer experience. The recently-introduced AOL-TV is based on ATVEF-compliant technology.

At the consumer premises, a "presentation engine" is used to render the ATVEF content. One such presentation engine is known as ATSC's (Advanced Television Systems Committee) DASE, and sits on top of the application execution engine, with access provided via Java API calls.

Many implementations of the ATVEF system employ Multicast IP for data transmission. In Multicast IP, data is conveyed in a part of the video signal that is not presented for display to the viewer.

In order for video equipment to be compliant with the ATVEF standard, it must

recognize the data conveyed with the content signal, and render it in accordance with the ATVEF specification. A layered architecture is generally employed.

Layered architectures are used in a variety of contexts. The lowest layer is commonly customized to the particular hardware being used. Higher layers are progressively more independent of the hardware - offering a hardware-independent interface for interacting with the system. By such approaches, software (and content) can more easily be used on a variety of different platforms, since the platform differences are masked by the layered architecture.

ATVEF-compliant set top box architectures include a cross-platform communication stack having a layer that provides detection of the Multicast IP data. This layer analyzes the video data for the Multicast information, and relays the decoded information to higher layers that make use of such information in augmenting the consumer's experience.

Likewise on the content origination side – a layered architecture is used. Such applications use stock IP protocols, such as Multicast or UDP. At (or near) the bottom of the stack different organizations have supplied a (Physical) layer to encode the signal into NTSC, PAL, DVB, etc. Traditionally, for each of these there is associated hardware (NABBTS encoder for NTSC, for example), that actually puts the data with the video.

In accordance with one embodiment of the invention, watermark encoder/decoder functionality is provided at a similar layer in compliant systems. On the content origination side, a physical layer is provided to watermark video in any desired video format (typically in the spatial domain, but alternatively watermarking in the compressed, e.g., DCT or MPEG, domains), hence reducing the amount of hardware and software needed to operate with different formats.

Likewise on the consumer side, a watermark detector is provided at a low level layer, serving to analyze the received video data for watermark information, and relay the decoded watermark information to higher layers that make use of such auxiliary information in augmenting the consumer's experience. (The video watermark decoder can be provided at the lowest – physical – layer, or at a higher level.)

By arrangements like that detailed above, interactive TV employs watermark data – conveyed "in-band" in image content, to augment the consumer's experience. Rather

than implementing the technology differently for every origination system and set top box hardware (and associated STB operating system) on the market, the watermark functionality is desirably incorporated into a pre-existing layered communication architecture. By such approach, the installed based of content authoring tools, clients, and content is un-affected, and implementation is greatly simplified.

To provide a comprehensive disclosure without unduly lengthening this specification, the patents and applications cited above are incorporated herein by references, together with application 09/571,422.

Having described and illustrated the principles of the invention with reference to illustrative embodiments, it should be recognized that the invention is not so limited.

For example, while the specification referred to a few examples of watermarking technology, the field is broad and growing. Any watermarking technology can be employed.

The implementation of the functionality described above (including watermark decoding) is straightforward to artisans in the field, and thus not further belabored here. Conventionally, such technology is implemented by suitable software, stored in long term memory (e.g., disk, ROM, etc.), and transferred to temporary memory (e.g., RAM) for execution on an associated CPU. In other implementations, the functionality can be achieved by dedicated hardware, or by a combination of hardware and software. Reprogrammable logic, including FPGAs, can advantageously be employed in certain implementations. Set top boxes typically incorporate some or all of such elements.

It should be recognized that the particular combinations of elements and features in the above-detailed embodiments are exemplary only; the interchanging and substitution of these teachings with other teachings in this and the incorporated-by-reference patents/applications are also contemplated.

In view of the wide variety of embodiments to which the principles and features discussed above can be applied, it should be apparent that the detailed embodiments are illustrative only and should not be taken as limiting the scope of the invention. Rather, I claim as my invention all such modifications as may come within the scope and spirit of the following claims and equivalents thereof.